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Design, Analysis, and Integration of an Electric Drive for Go-Kart Vehicles

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ABSTRACT

This transformation brings about a profoundly altered structure, one that takes the form of an open-frame with a linear chassis. The frame needs to possess sufficient stiffness to be able to handle huge loads, though this might result in a trade-off with flexibility. The aim is to form a vehicle that provides assurance and stability to the operator. All subsystems are conceptualized based on this goal as a basis, and all parts are then eventually integrated into a final setup. In order to enhance stability, the center of gravity is maintained as low as possible. The vehicle length is also kept to a minimum to minimize its overall weight. Wheelbase and track width are selected with caution, with the front track width kept to a minimum to enable a smaller turning radius and enhanced maneuverability.A kart is usually a car without differential or suspension but specifically built for racing on flat circuits. Electric motors offer a viable alternative to conventional engines, with comparable power output. Motor use in karting can transform both the design and performance of the cars to a great extent. This alteration produces a highly divergent form, which is characterized by an open-frame type with a linear chassis. The frame has to be rigid so that it can support heavy loads, even though it might be at the cost of flexibility. In order to provide greater stability, the center of gravity is maintained as low as possible. The vehicle length is also reduced in an effort to minimize overall weight. The track width and wheelbase are selected wisely, and the front track width is reduced to offer a smaller turning circle and greater maneuverability.

Keywords: Safety, Durability, Ergonomic, FEA, Aesthetics, DFMEA, DVP.

INTRODUCTION

A kart is usually referred to as a car lacking suspension and differential, specifically made for competitive racing on flat terrain. Since the mid-20th century, various engine-powered karts have been observed navigating the roads [14]. Due to the prevailing environmental concerns, there is increased advocacy for the development of environmentally friendly cars to reduce harmful emissions. Electric motors present a suitable option for replacing conventional engines, with similar power outputs [13]. Motor application in karting has the potential to revolutionize the design and performance characteristics of the vehicles. Electric go-karts are transforming the universe of kart racing by offering a clean, green, and exciting alternative to the conventional gas-guzzling karts [17].

With improvement in battery technology and efficiency, these go-karts provide immediate acceleration and fluid handling with an enjoyable ride devoid of noise and emissions compared to internal combustion engines [2]. Uptake of electric go-

karts also forms part of universal moves toward sustainable practices and environmentally friendly means, thus providing an increasingly favorable option for use in both indoor and outdoor race tracks [5]. Because they do not need more maintenance and they emit no harmful fumes, electric go-karts not only environmentally but also for operators and drivers in need of a quieter and more economical solution [25].

It is economically affordable and simple in design are the main characteristics of our cart which has numerous uses such as it can be used for Adventure and Sports [22]. Overall, the combination of environmental performance, cost-effectiveness, and exhilarating. Driving dynamics has rendered electric go-karts a progressively more appealing choice for individuals looking for an exciting fun & riding experience [9].

PROBLEM STATEMENT

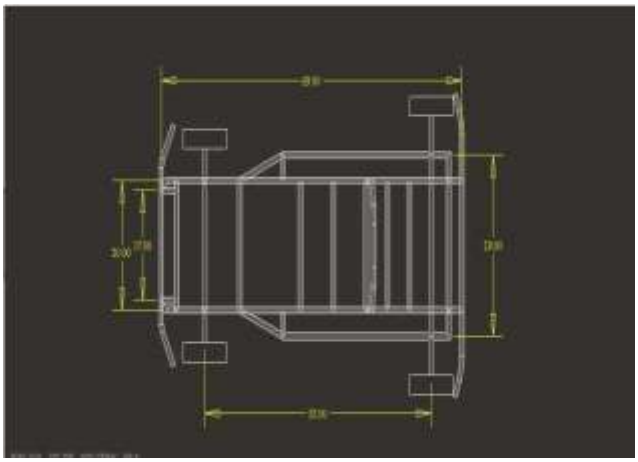
Traditional go-karts powered by internal combustion engines face challenges such as excessive weight, noise pollution, and reliance on non-renewable fuels. These limitations hinder their efficiency, environmental compatibility, and adaptability to modern recreational.

I. OBJECTIVES

- To design the skeleton of go-kart with proper stability and efficiency.
- To analyze the frame with structural analysis using the required software.
- To develop the working model.

LITERATURE REVIEW

[10], The go-karting project is to design a cost-effective go-kart within ₹70,000. It has an open straight chassis of AISI 4130 chromyl tube for safety and looks, The power and efficiency are provided by a Honda Activa 125cc 4-stroke engine [10]. The rack and pinion steering system gives precise control, and a chain drive facilitates effective power transmission [10]. Safety tests like impact analysis and acceleration calculations ensure performance standards and driver safety [10].

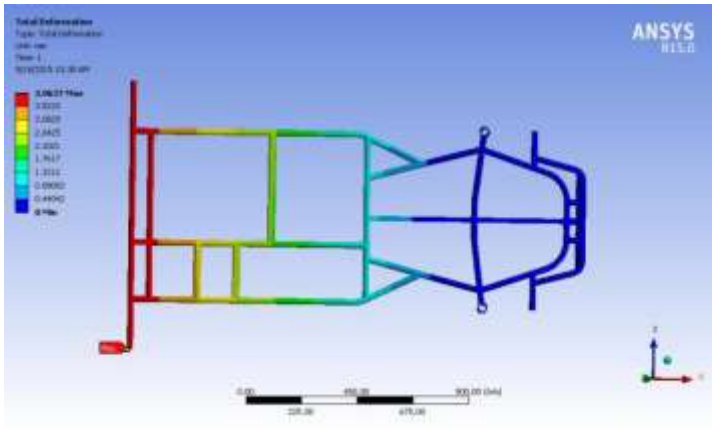


[12],This design approach optimizes material efficiency while ensuring the chassis withstands various loads. The key components include the chassis, axle, steering, engine, wheels, bumpers, and tires, with no suspension needed [12]. Both two-stroke and four-stroke engines are compatible, while the chassis ensures strength and stability. Go-karting is an exciting, cost-effective sport popular for indoor and outdoor tracks. The impact force was 3532N, displacement was 6.44mm, and the factor of safety was 1.8 [12].

[7], Switchingto electric motors is more efficient and less polluting. FEA confirmed safety of the chassis as it ensured that it could handle impact forces. The AISI-1018 steel chassis has structural strength without being too heavy, enabling improved handling.[7]. Low center of gravity and optimized wheelbase improve maneuverability and stability. Ackerman steering and hydraulic disc brakes for control and stopping power ensure a smooth ride.[7].

[20], AISI 1018 steel was selected for its excellent weldability and balanced toughness and strength, with a yield tensile strength of 370 MPa. The frame analysis confirmed acceptable deformation limits, with safety factors of 3.11 for front

impacts and 3.64 for rear impacts [20]. The body design ensures driver and component protection, featuring an ergonomic seat and clear vision cones. Powertrain calculations show an 88% CVT efficiency, optimizing performance. The engine, delivering 3.5 hp, enables a calculated maximum speed [20].



THEORETICAL ANALYSIS

[1]. Rolling resistance (Fr)

Fr = Mg × μ × cosΘ……[30]

= 150 × 9.18 × 0.015 × 1 = 22 N

[2]. Aerodynamic Drag (Fd)

Fd = ½ × ρ × A × Cd × v2……..[30]

= ½ × 1.25 × 0.54 × 0.5 × 12.5^2

= 27N

[3]. Acceleration force (Fa)

Fa = m × a……..[30]

= 150 × 0.9= 135N

[4]. Total tractive force

= (Fr) + (Fd) + (Fa) ……[30]

= 22+27+135

= 184N

[5]. Peak Power

= total tractive × v (max) ……[30]

= 184 × 12.5

= 2300 watt

[6]. RPM

= Speed × 60 /2πr = 3906 RPM……..[30]

[7]. TORQUE

= F × a……..[30]

= 12.87 Nm

[8]. BATTERY CALCULATION

❖ RANGE

$Range\ (Km) = BatteryCapacity\ (Ah) * Batteryvoltage\ (V) / Powerconsumptionrate\ (wh/km)$

……[30]

❖ We consider 20wh/km speed for 48v 15Amp

$Range = 48v * 15Ah / 20whpkm$ = 36 km

❖ We consider 25wh/km speed for 48v 15Amp

$Range = 48v * 15Ah / 25whpkm$ = 28 km

[9]. CHARGING TIME

❖ We consider 48v 6amp charger

$Chargingtime = batterycapacity\ (amp) / chargeroutputcurrent\ (amp)$
……[30]
We have used,
48v 15Amp battery = 15 (amp) / 6 (amp) = 2.5-hour approx.

[10]. Vehicle Specifications

Table.1 Specifications

Material	**Galvanized steel**
Chassis	**Rectangular box frame**
Total Length	**1422.4 mm**
Rectangular section	**2inch*1inch = 76.2mm**
Box Pipe thickness	**1.87mm**
Battery	**48 V, 48Ah Li-ion**
Overall weight	**150kg approx**

MATERIAL SPECIFICATION

- Strength and Weldability: Choose a material that's strong enough to withstand stress and easy to weld for structural integrity.
- Weight and Cost: Ensure the material is lightweight yet cost-effective.
- Recommended Material: 2mm thick MS AISI 4130 steel tubing for optimal strength, weight, and cost balance.

Table.2 Properties

PROPERTY	**AISI 4130 (MS)**
DENSITY(Kg/m^3)	**7850**
POISSON's RATIO	**0.3**
YOUNG MODULUS (Mpa)	**210**
TENSILE STRENGTH YIELD (Mpa)	**435**

Steering Mechanism

In a four-wheeled vehicle traveling along a curved trajectory, the lines drawn through the axes of all four wheels intersect at a point known as the instantaneous center of rotation. The center continues to shift as the front wheels alter their angles in an attempt to turn the vehicle in the desired direction [16].When the back wheels share a common axle but the front wheels are separate, the centers at the moment of rotation lie in a straight line through the back axle. The Ackermann steering geometry concept also applies to the rotary action of the front wheels, which are positioned at both ends of the axle beam for convenient turning [3].

Steering type: Ackerman Steering Geometry.

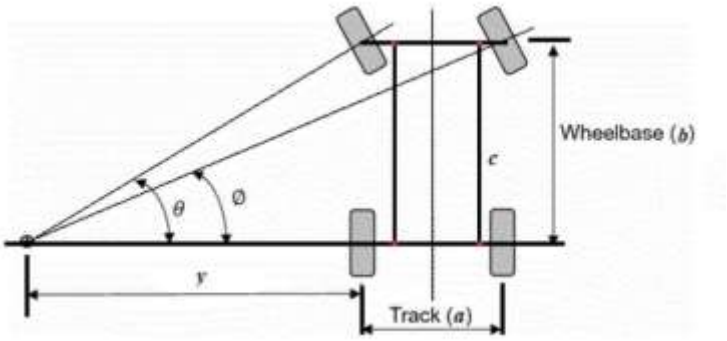


Fig.4 Ackerman Steering System [29].

MOTOR SPECIFICATION

A wheel hub motor, or hub motor, in-wheel motor, or wheel hub drive, is an electric motor integrated directly into the wheel hub, The motor powers the wheel directly [27]. The majority of electric vehicles, such as electric bikes, wheelchairs, and automobiles, employ batteries linked to a master motor. The motor propels two or four wheels via chains or gears. However, new technologies are following a different path [25].

In such sophisticated systems, every wheel has its own motor, eliminating the use of mechanical components to transmit power. This setup brings the motor and wheel together as a single unit, which is more efficient and responsive. This setup, also referred to as a hub motor system, is employed in our car, where we have included a 1000W motor to generate sufficient power and performance [8].

Type: BLDC Brushless Motor 48v 1000w.

II. BATTERY SPECIFICATIONS

- Lithium-ion batteries are great for performance go-karts due to their high energy density, lightweight build, and long cycle life.
- They enable quicker acceleration, longer run times, and improved handling.

Table.3 Specifications of Battery

Criteria	**Specification**
Supply Voltage	48V
Battery Current	48 AMPs
Weight	8 Kg
Cooling System	NATURAL COOLING
Charging Time	6hrs +

NUMERICAL ANALYSIS

Table.4 Design Parameters

Parameters	Values
Gross vehicle weight	150 kg
Overall length	1600 mm
Overall width	900 mm
Overall height	600 mm
Rolling resistance coeff.	0.015 μ
Drag coefficient	0.5
Frontal area (W×H)	0.54 m^2
Speed	45kmph = 12.5 m/sec
Acceleration (F-I)/T at 20kmph	(5.55-0)/6 = 0.925 m/sec^2
Wheel radius	4.5 inches = 0.11 m

- **Implementation :**
  During the system design stage, the go-kart was simulated using SolidWorks, a computer-aided design (CAD) program. According to the project idea, the general design adheres to the standard configuration of a standard go-kart, with the only modification being the application of Galvanized Steel as the frame material. This was done to suit our particular project needs. The images below of the model give a visual description and hands-on knowledge of the go-kart design:

- **Design of Frame :**

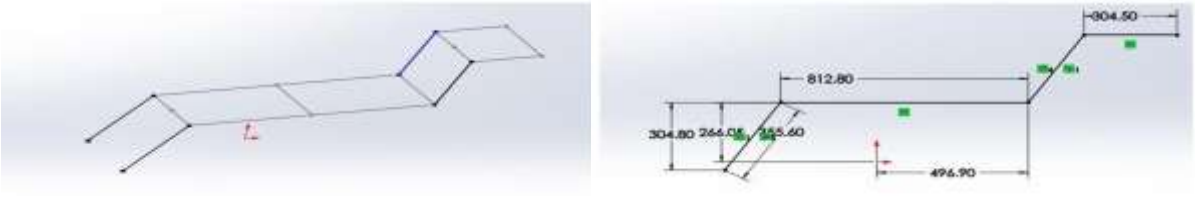


Fig.5 Design of chasis with Dimensions

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Fig.6 Conventional Chassis Frame

Displacement after applying load:

Fig.7 Result after Displacement

Results after Test:

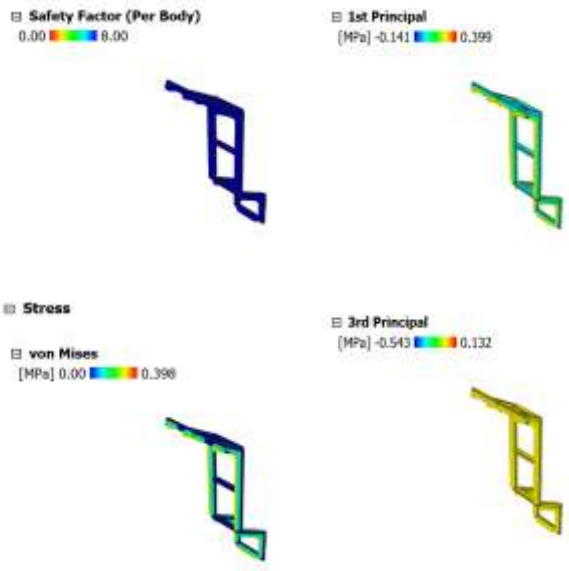

Fig.8 Results

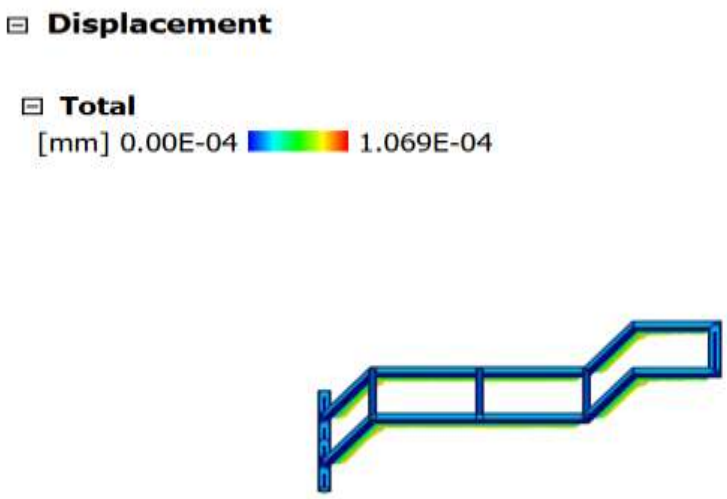

Fig.9 Analytical Result.

Here the electric gokart design, analysis and development focuses on how engineers can ensure safety, high performance and reliability. The design process uses tools such as FEA (Finite Element Analysis) and software such as Fusio n 360, CREO 3.0 and SolidWorks to find the best balance between power, weight and cost. Good materials and design are essential to creating a safe and secure gokart [23].

During the research we found that using high strength steel such as AISI 1018 and AISI 4130 for the chassis helps the kart remain stable and strong even without impact [4]. Tests conducted by FEA confirmed that the chassis can withstand a lot of force and stress while remaining safe with a safety factor of between 1.8 and 3.77, depending on the type of crash [11]. Excellent performance is essential for the job

Manufacturing Images

Fig.11 Manufacturing of chassis

CONCLUSION

In summary, go-kart electric vehicle (EV) frame design and construction demand a careful consideration of factors to provide maximum performance and safety. The strong yet light frame made of high-strength alloys or composites is a key factor to meet the required weight distribution and strength.

Special care must be taken in determining the location of electric parts, including the motor and battery pack, plays a critical role to enhance the vehicle's center of gravity for stability and handling.

The recurring cycle of testing and analysis, typically aided by computer-aided design tools, is paramount to fine-tune the go-kart EV frame to achieve high levels of performance, safety, and sustainability in electric mobility.

Finally, a properly designed frame is the key to unlocking the full capability of a go-kart EV, providing a thrilling and eco-friendly driving experience

REFERENCES

[1]. Mohan Kulkarni, Rishi Panchal, (2023), End of line diagnostics system analysis enrichment of electric vehicles, Semiconductor Optoelectronics, Vol. 42 No. 1 (2023), 907-928 https://bdtgd.cn/article/view/2023/907.pd

[2]. N.A.Z. Abdullah1,*, M.S.M. Sani1,*, N.A. Husain2, M.M. Rahman3, I. Zaman4, (2017), Dynamics properties of a Go-kart chassis structure and its prediction improvement using model updating approach, International Journal of Automotive and Mechanical Engineering, Vol. 14 No. 1 (2017): March, ISSN: 2229-8649 https://journal.ump.edu.my/

[3]. Mohan Kulkarni, Rishi Panchal,(2023), Enhancement in electric circuit first time quality improvement of electric vehicles, Corrosion and Protection, Vol. 51 Issue.1 (2023), ISSN:1005-748X, Pg.497-527, https://www.fsyfh.cn/view/article/2023/497.php

[4]. MohdFitri Arshad1, Muhammad Faris Ahmad1, Amir Khalid1, Izuan Amin Ishak1*, Shaiful Fadzil Zainal Abidin1, MohdAzahari Razali2,(2022), Investigation The Influences of Electric Motor and Electric Go Kart Performance, Journal of Automotive Powertrain and Transportation Technology, 2022, VOL. 2 NO. 2 (2022) 17-23, e-ISSN: 2821-286X https://publisher.uthm.edu.my/ojs/index.php/japtt

[5]. Mohan Kulkarni, Atharva Bagrao,(2024),Numerical Investigation of Anti-Reverse Differential Mechanism Employed in Manual Transmission, International Journal of Research in Engineering and Science (IJRES),ISSN (Online): 2320-9364, ISSN (Print): 2320-9356 ,Volume 12 Issue 5 ǁ May 2024 ǁ PP. 95-107, www.ijres.org

[6]. KoustubhHajare, Yuvraj Shet, Ankush Khot,(2016), A Review Paper on Design and Analysis of a Go-Kart Chassis, International Journal of Engineering Technology, Management and Applied Science, February 2016, Volume 4, Issue 2, ISSN 2349-4476 www.ijetmas.com

[7]. Naveen Kumar1, Sumit Mishra2, Sidharth Mishra3, (2020), Design and Analysis of ELECTRIC GO KART, November 2020, Conference: 2nd Virtual National Conference on Advancement in Materials Processing Technology (AMPT-2020) 31st October 2020 - 2nd November 2020, Organized by Department of Metallurgical and Materials Engineering,NITJAMSHEDPUR, https://www.researchgate.net/publication/345416536

[8]. Mohan Kulkarni, Atharva Bagrao,(2024), Design and Fabrication of Anti Reverse Differential for Heavy Commercial Vehicle, International Journal of All Research Education and Scientific Methods (IJARESM), ISSN: 2455-6211, Volume 12, Issue 3, March-2024, www.ijaresm.com

[9]. Mohan Kulkarni, Sumedh Sunil Vidhate,(2019), Study and Investigation on Recent Trends in Electric Vehicles, International Journal for Scientific Research & Development (IJSRD), Vol. 7, Issue 03, 2019, ISSN: 2321-0613, www.ijsrd.com

[10]. Abhinay Nilawar1, Harmeet Singh Nannade2, Amey Pohankar3, Nikhil Selokar4, (2016), DESIGN OF GO-KART, (2016), International Journal For Engineering Applications and Technology, ISSN: 2321-8134 http://www.ijfeat.org

[11]. Mohan Kulkarni, Sagar Gite, Aditya Ingole,(2017),Experimental Investigation and testing of Diesel engine and Analysis of exhaust gases by using Aqua Silencer, International Engineering Research Journal (IERJ), Volume 2 Issue 8 Page 2496-2500, 2017 ISSN 2395-1621, http://www.ierj.in

[12]. 1Ujjal Kalita, 2Yenduru Surya Teja, 3Darisi Sri Veera Venkata Manikanta, (2018), Design and Analysis of Go-Kart Chassis, International Journal of Engineering Development and Research, April 2018, Vol.6, Issue 2, page no.290-295, ISSN:2321-9939, https://rjwave.org/IJEDR/viewpaperforall?paper=IJEDR1802051

[13]. Mohan Kulkarni, Shubham Ghule, Kiran Supekar,(2017), Statistical analysis and testing of aqua silencer through experimental set up of diesel engine, International Engineering Research Journal (IERJ), Volume 2 Issue 9 Page 3212-3217, 2017 ISSN 2395-1621, www.ierjournal.org

[14]. Mainak Mitra1*, C. G. Shreesh Kaushik2, Saif Ahmed Shabbeer3, Saurav Ravi Palan4, Mahesh Shetty5,(2020), Design and Analysis of a Go-Kart, International Journal of Research in Engineering, Science and Management, July 2020, Vol. 3 No. 7, pp. 283–288, https://journal.ijresm.com/index.php/ijresm/article/view/78

[15]. Mohan Kulkarni,V.S.Dhumal,(2013), Study of MHD Flow in Parallel Pipe with Parallel and Counter Flow Pattern Using CFD Analysis, International Journal of Engineering Research and Applications (IJERA) Vol. 3, Issue 1, January -February 2013, pp. UGC approved journal-4525, ISSN:2248-9622, http://www.ijera.com

[16]. Sangeetha Krishnamoorthi *, L. Prabhu, MD Shadan, Harsh Raj, Nadeem Akram, (2018), Design and analysis of electric Go-Kart, Journal of Emerging Technologies and Innovative Research (JETIR), Volume 45, Part 7, 2021, Pages 5997-6005, https://doi.org/10.1016/j.matpr.2020.09.413

[17]. Mohan Kulkarni, S.S.Kore,(2012),Performance Characterization of Single Cylinder DI Diesel Engine Blended with castor oil and Analysis of Exhaust Gases, International Journal of Engineering Research and Technology, Vol.2 (02),2012,ISSN2278–0181 Reg.No.-2IS2091, http://www.ijert.org

[18]. Mohan Kulkarni, V.S.Dhumal,(2012), Performance Characterization of Single Cylinder DI Diesel Engine Fueled with castorbiodiesel, International Journal of Engineering Research and Technology, Vol. 1 (10), Dec. 2012. ISSN 2278 – 0181Reg.No.-IJERTV1IS10007, http://www.ijert.org

[19]. Tyrone Machado, Prof. Vijay Kulkarni, Design and Development Of a Go Kart, (2015) International Conference on Technologies for Sustainable Development (ICTSD), 30 April 2015,DOI:10.1109/ICTSD.2015.7095881,https://ieeexplore.ieee.org/abstract/document/7095881

[20]. ANJUL CHAUHAN, LALIT NAAGAR, SPARSH CHAWLA,(2016), Design and Analysis GO-KART, International Journal of Aerospace and Mechanical Engineering, September 2016, Volume 3 – No.5, ISSN (O): 2393-8609, http://www.ijamejournals.com

[21]. Karan Parihara, Neeraj Negib, DivyanshuDimric, Gaurav Ramolad, Dheeraj Bhatte, Subhash Gadalf, Nikhil Singhg, Jagdeep Singhh., (2018), Study and Examine the GO-CART working Mechanism, International Journal of Advance Research and Innovation, 2018, Volume 8, Issue 12, December-2017, ISSN 2229-5518, http://www.ijser.org